

NON-PUBLIC?: N
ACCESSION #: 9104220351
LICENSEE EVENT REPORT (LER)

FACILITY NAME: SAN ONOFRE NUCLEAR GENERATING STATION, PAGE: 1
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UNIT 3

DOCKET NUMBER: 05000362

TITLE: UNIT 3 AUTOMATIC REACTOR TRIP DUE TO NON-1E
UNINTERRUPTIBLE POWER
SYSTEM FAILURE
EVENT DATE: 03/15/91 LER #: 91-001-00 REPORT DATE: 04/15/91

OTHER FACILITIES INVOLVED: NONE DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: R. W. Krieger, Station Manager TELEPHONE: (714) 368-6255

COMPONENT FAILURE DESCRIPTION:
CAUSE: B SYSTEM: EE COMPONENT: CAP MANUFACTURER: X999
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At 0938 on March 15, 1991, Unit 3 automatically tripped from 100% power on a reactor protection system loss of load (LOL) signal. The LOL signal was caused by a turbine trip, which occurred as the result of a momentary interruption in power from the non-1E uninterruptible power system (UPS), de-energizing bus 3Q069. Emergency Feedwater Actuation System (EFAS) 1 and EFAS 2 actuations properly occurred. One non-1E 4.16 kV (3A03) bus did not automatically transfer from its normal power source to its alternate power source, resulting in the loss of the alternate power supply (3B012) to the non-1E bus 3Q069. One main steam safety valve lifted for a short time and properly reseated. At 1000, when 3A03 was manually reenergized, power was restored to 3Q069. Appropriate actions were taken in accordance with procedures to compensate for the operation

of control systems which were affected by the loss of power to the non-1E UPS. Post-trip plant recovery otherwise proceeded normally.

An output capacitor in the constant voltage transformer (CVT) section of the non-1E UPS inverter failed causing the momentary interruption in power from the non-1E UPS.

All capacitors in the Units 2 and 3 non-1E UPS were replaced with an upgraded model. The Unit 3 instrument busses powered by the non-1E UPS were modified such that power will be maintained to critical component systems (i.e., feedwater, turbine governor, and control element drive mechanism control systems) in the event of similar failures.

END OF ABSTRACT

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Plant: San Onofre Nuclear Generating Station

Unit: Three

Reactor Vendor: Combustion Engineering

Event Date: 03-15-91

Time: 0938

A. CONDITIONS AT TIME OF THE EVENT:

Mode: 1, 100% Power

B. BACKGROUND INFORMATION:

1. Non-1E Uninterruptible Power System (UPS) EE!:

Unit 3 non-1E instruments and control systems are energized by non-1E instrument bus BU! 3Q069. 3Q069 is supplied power from either the UPS inverter INVT! 3Y012 (normal source) or 480 VAC load center 3B012 EC, SWGR! (alternate source). Load center 3B012 is supplied power from 4.16 kV bus 3A03. On a loss of power from the inverter, the non-1E UPS static switch ASU! automatically transfers bus 3Q069 to the alternate source without power interruption. 3Q069 can also be energized directly from 3B012 via a manual bypass switch HS!. (See the following figure.)

2. Non-1E 4.16 kV Switchgear 3A03:

During normal power operations, non-1E 4.16 kV bus 3A03 is supplied through the Unit Auxiliary Transformer (3XU1) from the

Unit 3 Main Generator. Upon a unit trip, the power supply for 3A03 is transferred automatically to the Reserve Auxiliary Transformer (3XR1), which is supplied from offsite power. This automatic transfer occurs when the main generator output is at approximately eight megawatts. This happens less than one second after the turbine trip occurs. (See the following figure.)

3. Steam Bypass Control System (SBCS) II!:

The SBCS, which is a non-safety system and is not credited in any accident analysis, is provided to limit an increase in steam generator (SG) SG! pressure which can occur following plant transients such as a turbine trip. The SBCS controls SG pressure by venting steam from the SGs to the main condenser SG, COND!. The SBCS consists of four valves V!, associated piping, and control circuitry. A "Quick Open" signal is generated by the SBCS control circuitry to rapidly open all four valves in response to an abrupt decrease in steam demand by the main turbine, which occurs following a turbine trip. After the SBCS valves quick open, they modulate steam flow in order to maintain the SGs at the specified setpoint pressure. The SBCS control circuitry is powered from 3Q069. If the SBCS is unavailable, the SG atmospheric dump valves (ADVs) SB! may be used to control SG pressure.

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Figure 1 - "Non-1E UPS, Power Sources and Loads" omitted.

C. DESCRIPTION OF THE EVENT:

1. Event:

At 0938 on March 15, 1991, Unit 3 automatically tripped from 100% power on a reactor protection system (RPS) JC! loss of load (LOL) signal. The LOL signal was caused by a turbine trip, which occurred as a result of a momentary interruption in power to non-1E bus 3Q069. Emergency Feedwater Actuation System (EFAS) BA! 1 and EFAS 2 actuations occurred (as expected) due to the SG level "shrink" in response to the reactor trip.

One 4.16 kV bus (3A03) did not automatically transfer from its normal power source (3XU1) to its alternate power source

(3XR1), resulting in

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the loss of the alternate power supply to the non-1E bus 3Q069 less than one second after the momentary interruption in power to 3Q069. Since 3Q069 was being supplied from 3A03, this in turn, caused the loss of instrument buses No. 1 and 2, the turbine instrument bus, and the computer bus (all powered from 3Q069), which resulted in a power loss to non-safety related Control Room (CR) instruments for 22 minutes. At approximately 1000, 3A03 was reenergized from 3XR1, followed by the reenergization of 3Q069.

Appropriate actions were taken in accordance with procedures to compensate for the operation of control systems which were affected by the loss of power to the non-1E UPS. Post-trip plant recovery otherwise proceeded normally.

Although the SBCS valves quick opened as designed upon the reactor trip, the loss of power to 3A03 deenergized the SBCS control circuitry causing the valves to close. As a consequence, SG pressure steadily increased during the next several seconds and peaked at approximately 1100 psia, the pressure corresponding to the lowest lift setpoint of the main steam safety valves (MSSV) RV! for each SG. One MSSV on SG E088 was determined to have briefly lifted and properly reseated. Control room operators (utility, licensed) opened the Atmospheric Dump Valves (ADVs) to reduce SG pressure.

2. Inoperable Structures, Systems or Components that Contributed to the Event:

None.

3. Sequence of Events:

TIME ACTION

0938 Unit 3 reactor tripped due to de-energization of Non-1E UPS. One MSSV for SG E088 briefly lifted.

1000 At approximately 1000, 3A03 was reenergized from 3XR1, followed by the reenergization of 3Q069.

4. Method of Discovery:

CR indications and alarms alerted the operators to the reactor trip and de-energization of the non-1E UPS.

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5. Personnel Actions and Analysis of Actions:

The operators (utility, licensed) responded properly to the reactor trip, verified proper operation of EFAS, and stabilized plant conditions in accordance with applicable procedures.

6. Safety System Responses:

The RPS and EFAS, and all actuated components operated as designed.

D. CAUSE OF THE EVENT:

1. Immediate Cause:

The reactor tripped on a LOL signal. A momentary interruption in phases "B" and "C" power to bus Q-069, coupled with a probable resultant disturbance to the phase "A", resulted in a loss of power to the main turbine electronic governor TG! which initiated a turbine trip and closure of the high pressure stop valves (HPSVs) ISV!. Closure of the HPSVs resulted in low hydraulic pressure in the associated unitized actuators HCU!, generating the LOL signal.

2. Root Cause:

An output capacitor CAP! between phases "B" and "C" in the constant voltage transformer (CVT) XFMR! section of the non-1E UPS inverter output failed, causing the internal inverter voltage to momentarily decrease and current to momentarily increase, initiating an automatic transfer of the non-1E UPS. Since the static switch overcurrent sensors measure only load currents (not internal fault currents), the static switch transfer was not initiated until a decrease in output voltage was detected. With the short circuit occurring directly at the CVT, the internal energy normally stored in the CVT was shunted and unavailable to sustain the loads during the transfer. This resulted in a brief power interruption before the static switch transferred to its alternate source. This power interruption was sensed by the main turbine electronic governor TG!, which

initiated a turbine trip resulting in a LOL signal to the RPS.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

a. All capacitors in the Unit 2 and 3 non-1E inverters were replaced with an upgraded model.

b. The Unit 3 instrument busses powered by the non-1E UPS were modified such that power will be maintained to critical component systems (i.e., feedwater, turbine governor, and control element drive mechanism control systems) in the event of similar failures.

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2. Planned Corrective Actions:

The modification described in Section E.1.b above will be implemented on Unit 2 during the next unit outage of sufficient duration.

F. SAFETY SIGNIFICANCE OF THE EVENT:

There is no safety significance to this event since all safety and protective systems operated in accordance with the design.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:

The failed 13 microfarad capacitor (part no. CDE KBXK1056PI or SCI 020138), was manufactured by Cornell-Dublier Electric (CDE). In 1983, the manufacturer of the non-1E UPS, Solidstate Controls, Inc. (SCI) identified a generic manufacturing defect and inadequate design of this capacitor model (which were manufactured in 1981, 1982, and 1983). These deficiencies resulted in a high rate of capacitor short circuits.

SCI discontinued use of this capacitor in August 1983 and recommended their replacement with part no. SCI 020139, which is a dual capacitor design in one container. This dual capacitor design prevents a single capacitor short circuit from causing the inverter output to fail.

This information was detailed in a failure analysis report by SCI (dated August 1983). This report also identified 26 industry incidents attributable to capacitor failures, six of which resulted in a complete loss of power to the UPS bus, similar to the event described in this Licensee Event Report.

When SCE became aware of the aforementioned history of defective capacitors in December 1990, the capacitors in Unit 2 and Unit 3 were not replaced with the upgraded model because: 1) the new model capacitor was not available on site; 2) not all the capacitors could be safely replaced (personnel safety); and 3) there was concern that if all capacitors were replaced, premature failure (infant mortality) of the capacitors could cause another trip.

2. Previous LERs for Similar Events:

LER 90-016 (Docket No. 50-361) reported a similar event at Unit 2 involving a reactor trip caused by the non-1E UPS. The corrective actions described in that LER had not been implemented in Unit 3, for the reasons described in Section G.1 above, at the time of the event being reported in this LER.

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3. Other Information:

a. Non-1E Switchgear 3A03:

Switchgear 3A03 did not automatically transfer to Reserve Auxiliary Transformer 3XR1 since the feeder breaker from 3XU1 had a loose pin on its cell switch pivot arm. The loose pin caused the transfer scheme of the reserve auxiliary breaker to fail by blocking a permissive from the unit auxiliary breaker cell switch. The blocked permissive prevented the time delay relay from operating and prevented closure of the feeder breaker from 3XR1 to 3A03. The manual hand switch in the CR bypasses this portion of the control circuit and allowed the breaker to be closed manually. The loose pin was repaired by welding it in place. All other 6.9 kV and 4.16 kV breakers in Units 2 and 3, which are involved in bus transfer schemes and contain a cell switch mechanism such as this, were verified to be functioning properly.

b. Main Steam Safety Valves (MSSV):

One MSSV briefly lifted during this event. The valve was tested and determined to be lifting at the correct pressure setpoint.

c. Sequence of Events (SOE) Computer Printout:

As described in LER 90-016 (Docket No. 50-361), the plant computer ID# generates an SOE report for significant transients such as reactor trips. The SOE report provides information used to determine or confirm the cause of the transient. In this particular event, the SOE report contained information which is anomalous. Specifically, the SOE report recorded that the LOL trip occurred after three of the eight reactor trip breakers opened. However, SCE's post-trip review concluded that the disturbance in the non-1E instrument bus power supply most likely resulted in non-sequential recording of some plant equipment status changes by the SOE.

Our investigation into this aspect of the event is continuing; the results of the investigation will be reported in a supplement to LER 90-016 (Docket No. 50-361).

ATTACHMENT 1 TO 9104220351 PAGE 1 OF 1

Southern California Edison Company

SAN ONOFRE NUCLEAR GENERATING STATION
P. O. BOX 128
SAN CLEMENTE, CALIFORNIA 92674-0128

R. W. KRIEGER TELEPHONE
STATION MANAGER (714) 368-6255

April 15, 1991

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Subject: Docket No. 50-362
30-Day Report
Licensee Event Report No. 91-001

San Onofre Nuclear Generating Station, Unit 3

Pursuant to 10 CFR 50.73(d), this submittal provides the required 30-day written Licensee Event Report (LER) for an occurrence involving an automatic reactor trip. Neither the health nor the safety of plant personnel or the public was affected by this occurrence.

If you require any additional information, please so advise.

Sincerely,

Enclosure: LER No. 91-001

cc: C. W. Caldwell (USNRC Senior Resident Inspector, Units 1, 2 and 3)

J. B. Martin (Regional Administrator, USNRC Region V)

Institute of Nuclear Power Operations (INPO)

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